NASA TECH BRIEF

Electronic Calorimetric Computer
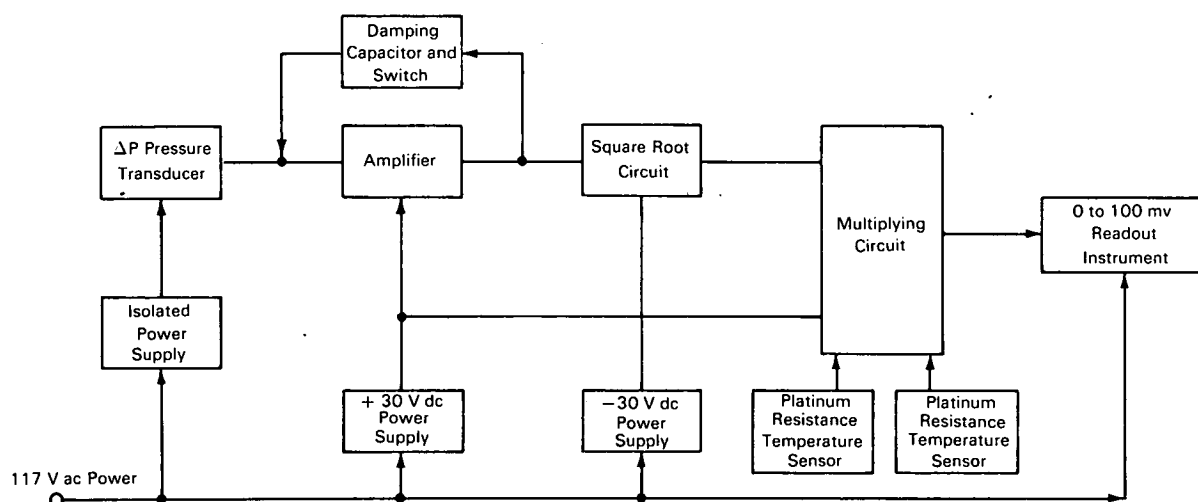
A calorimetric computer has been designed to calculate nuclear reactor thermal power output to a nominal accuracy of 1%. A heat balance is determined by an electronic rather than an electromechanical approach. The thermal power is calculated using the inlet and outlet temperatures and the volume of cooling water. This power or, selectively, any of the component function values, can be displayed by a digital readout system.

In operation, two similar channels operate from a common +30 vdc and −30 vdc power source. Each channel uses three sensors to gather data: a differential pressure (ΔP) transducer whose voltage output is a function of coolant flow, and two platinum temperature sensitive resistors that measure the system differential temperature (ΔT). The thermal power is proportional to flow times ΔT.

A highly regulated dc voltage is applied to the ΔP transducer whose output of approximately 0 to 25 mv is raised to 0 to 10 v by the amplifier whose gain is varied to span the channel. Damping in the coolant flow circuit is by a capacitor in the feedback loop of the amplifier. Output of the amplifier is fed to the square root circuit whose 0 to 10 v output is proportional to coolant flow. Flow $= K\sqrt{\Delta P}$, where K is a constant determined by circuit values and flow tube characteristics. The square root circuit consists of an operational amplifier with a special nonlinear resistor, having a parabolic e vs i characteristic, in its feedback circuit. This resistor is mounted in an oven operated at constant temperature to maintain an accuracy of 0.2%.

The multiplying circuit is a bridge that provides the product of a voltage proportional to coolant flow and a differential resistance proportional to differential temperature, the resultant product being a voltage proportional to reactor thermal power. The platinum temperature sensitive resistors, sensing core inlet and

(continued overleaf)

core outlet temperatures, form two legs of the bridge, whose excitation voltage is the output of the square root circuit.

Notes:

1. With modification, this computer could be used to monitor or control either or both flow systems of heat exchangers in industrial applications.

2. Inquiries concerning this innovation may be directed to:

      Technology Utilization Officer
      Lewis Research Center
      21000 Brookpark Road
      Cleveland, Ohio 44135
      Reference: B68-10138

Patent status:

No patent action is contemplated by NASA.